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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
Federal-State Joint Board on Universal Service	)	CC Docket 96-45
	)	
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs.	)	CC Docket 97-160

JOINT REPLY COMMENTS OF BELLSOUTH CORPORATION, BELLSOUTH TELECOMMUNICATIONS, INC., US WEST, INC., AND SPRINT LOCAL TELEPHONE COMPANIES TO FURTHER NOTICE OF PROPOSED RULEMAKING SECTIONS III.C.2

SPRINT LOCAL TELEPHONE COMPANIES

Jay C. Keithley
Sandra K. Williams
1850 M Street, NW
Suite 1100
Washington, D.C. 20036
(202) 828-7453

Attorneys for Sprint Local Telephone Companies

US WEST, INC.

Robert B. McKenna
John L. Traylor
Suite 700
1020 19th Street, N.W.
Washington, D.C. 20036
(303) 672-2798

Of Counsel, Dan L. Poole

BELLSOUTH CORPORATION
BELLSOUTH TELECOMMUNICATIONS, INC.

M. Robert Sutherland
Richard M. Sbaratta
Rebecca M. Lough
Suite 1700
1155 Peachtree Street, N.E.
Atlanta, GA 30309-3610
(404) 249-3390

Their Attorneys

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SUMMARY

The filings offered in this comment cycle support the superiority of BCPM's network design over that offered by the Hatfield model. With its only goal being to create a low cost theoretical network, Hatfield once again reveals that it is willing to sacrifice both customer service and quality to attain that goal. This fact is magnified in the comments filed by the Hatfield sponsors in which they ignore the realities of structure sharing and assume instead that a perfect world exists. The Joint Sponsors of BCPM respond to Hatfield's flawed reasoning by pointing out that in real world circumstances, complications arise such as the timing of construction activity with other utilities, which is then compounded by extra costs being incurred.

The engineering design of the loop is, of course, of critical importance. The comments filed in this matter, especially those of current local service providers, show the flaws in the Hatfield model's loop design theory. The Hatfield model sponsors themselves add to the litany of defects in their model by suggesting the use of a 1500 ohm standard - in direct contravention of the directives offered in AT&T's own Outside Plant Engineering Handbook.

Similarly, the use of the 1500 ohm design standard would necessitate the use of a higher priced extended-range line card; of course, Hatfield does not include the price of this equipment in it costs. The model must either be revised to do so or reworked to conform to the loop design standards provided in the CSA specifications and ohms law. BCPM has already been configured to take advantage of the economies inherent in the CSA design architecture, which provides for state-of-the art network architecture which may be seamlessly connected to the worldwide telecommunications network.

The Hatfield sponsors attempt to claim that BCPM overbuilds its network. However, the Joint Sponsors provide ample proof that, not only is this allegation

unfounded, but that BCPM's network design is in keeping with the directives of the Commission with respect to both the deployment of advanced services and the inclusion of business lines and residential lines in the same network.

Finally, the Joint Sponsors are pleased to read the comments of wireless providers and vendors as to the attributes of wireless technology. It is our hope that by working closely with these commenters, the Joint Sponsors will be able identify a working wireless application and modify BCPM, if appropriate, to reflect the actual cost of wireless technology.

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Bell South, US West and the Sprint Local Telephone Companies (hereinafter "Joint Sponsors") respectfully submit their replies to comments filed on September 24, 1997 in the above-captioned matter.

I. Plant Mix

The Florida Public Service Commission repeatedly expresses its belief that states should be able to reflect regional, state, or even wire center differences for various inputs. The Joint Sponsors would like to point out that the BCPM model is, in fact, designed to be run at the state level and, therefore, regional and/or state-specific inputs can be reflected. Although the BCPM is not designed to accommodate different sets of inputs at the wire center level, many of the wire center differences can be reflected by differing inputs by density zones.

II. Structure Sharing

The Hatfield Model Sponsors state that they believe the Commission's tentative conclusion for structure sharing (100% of buried and 66% of underground and aerial to telephone) is "seriously wrong"[1], offering record evidence that they believe contradicts the tentative conclusion. The examples offered, found in footnote 118 of the FNPRM, reflect GTE's experience of 97.5% buried cable and between 57% and 61% in the aerial category. While these numbers are not exactly 100% and 66%, they certainly do not vary enough to qualify the Commission's tentative conclusion as "seriously wrong". Finally, this same footnote shows the GTE experience as 95%-99% for underground plant. How can the Hatfield Sponsors hold up these results as unfavorable when the tentative conclusion is a much lower assignment to telephone (66%)? The clear answer is that they cannot.

At pages 5-6 of its comments, the Rural Utilities Service ("RUS"), as the commenting entity most closely aligned to rural areas (which are the areas most likely to need support), provides insight as to why sharing does not occur more often in rural areas. Specifically:

- participating utilities would have to place facilities at the same time;
- physical separation of facilities is the best and least expensive way to minimize power line-induced noise; and
- few RUS-financed companies parallel CATV facilities.

For these reasons, RUS warns that structure sharing assumptions should not be applied in any fashion to rural buried plant.

In yet another example of how the Hatfield sponsors are willing to sacrifice customer service and quality for a lower cost theoretical network design is revealed in their use of structure sharing. As the Joint Sponsors, as well as many other commenters have stated, it is possible, in some limited circumstances, to share structures with other telecommunications carriers and/or utilities. This occurs most frequently in the construction of new residential subdivisions. While sharing is sometimes possible in other parts of the network, the reality is that doing so usually

[1] AT&T/MCI Comments at p. 12

involves complications in the timing of construction activity with other utilities, and often involves extra costs. In typical fashion, however, the Hatfield sponsors ignore these realities and instead assume that the best of all possible worlds exists in all cases.

In the context of determining the necessary explicit support for service in high cost rural areas, the Hatfield sponsors make the following assumptions:

- For each customer who requests service, one to three other utilities will materialize simultaneously to share in the costs of construction; and
- None of these other utilities will require high-cost support, even in the most costly rural areas.

While these assumptions will lead to a significantly lower high-cost fund, they will fail in the mission to assure affordable service to customers in rural areas. Assume, for example, that a customer requests service in an area where it will cost $40,000 to extend facilities. The fund will only provide $10,000 to $20,000 of support to a provider to build. Unless the network provider can find other parties to put up the other $20,000 to $30,000, it will have no incentive to provide service to this customer. By assuming a realistic level of structure sharing, the BCPM would calculate support that assures such customers receive appropriate support and service.

The Joint Sponsors have endeavored to identify a realistic estimate of what structure sharing is reasonable and possible, and have included these assumptions in the structure cost tables of the enhanced BCPM.

III. Loop Design

As the Commission is well aware, the engineering design of the loop is of critical importance. It is, of course, the loop that enables the network to establish a connection to a distant point; the customer to draw dial tone, and the central office to receive the routing information as the customer "dials" the desired number. Equally important, however, is to ensure that once the connection is established, the transmission quality is within acceptable standards affording end users clear transmissions capabilities Consequently, the outside plant engineer must deal with the reality of the laws of physics [Ohms Law] and electronics in designing loops which accomplish all of these tasks.

It must be remembered that the telephone network is just that - a connection of two ends, the sum of which determines how efficiently the network, as a whole, will function. It is for this reason that worldwide standards have been established for the design of customer loops. By following these standards, engineers can be assured that the loops they design will function in a seamless worldwide network. Equipment manufacturers know these standards and design their equipment to function within the relevant parameters. Deviation from these standards invites trouble, affecting either the ability of the network to function, or the satisfaction of customers regarding the quality of the network connection or both.

The Telecommunications Act of 1996 provides some guidance on the issue of network design. The Act mandates that customers in rural areas shall have access to services which are equal in quality to those available in urban areas[2]. Moreover, the Act recognizes that Universal Service is comprised of an evolving level of telecommunications services[3]. It would, therefore, be extreme folly to design a "forward-looking" network based on antiquated technology, especially when that outmoded technology could only be made compatible with more advanced technologies by costly overbuilds of the network.

From an engineering perspective, the rules governing network design are intended to insure that:

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[2] 47 U.S.C. 254 (b)(3).
[3] Id. at (c)(1).

1. No loop exceeds the office signaling range;
2. All customers receive sufficient current over the loop to power the station set; and
3. The loop transmission loss on both ends of the connection is satisfactory.[4]

In turning these rules into engineering practices, there are two generally accepted conventions - Revised Resistance Design (RRD) and the Carrier Serving Area (CSA) Philosophy. The CSA is the more current technology standard, and results in the design of a network which is capable of providing "...voice-grade message service, digital data service up to 64 kbps, Digital Subscriber Lines (DSLs) for ISDN, and most locally switched, 2-wire, voice-grade special services"[5]. Since CSA provides the modern telecommunications services which customers demand - and the comments filed in this matter on behalf of local network providers indicate that they use the CSA design standards[6]- the Joint Sponsors recommend the CSA design standard be used in the Commission's chosen proxy model.

The *AT&T Outside Plant Engineering Handbook* provides particularly succinct descriptions of these two network design standards:

Resistance Design (Page 5-3)

- Maximum conductor loop resistance of 1500 ohms without loop electronics (central office range permitting).[7]
- Load all loops over 18 Kft, which includes bridged tap.
- Resistance design principles can only be applied to loops which originate at the central office. It cannot be applied within a carrier serving area

Carrier Serving Area (CSA) (Page 13-1)

- The wire center is sectionalized into discrete geographical areas, or CSAs, beyond 12,000 feet of the central office.
- Each CSA will ultimately be served via a remote terminal (RT) which houses the digital carrier equipment and divides the feeder from the distribution network.

[4] BOC Notes on the Network, April 1994, Page 7-66.
[5] Id at pp. 7-69.
[6] See, comments of Bell Atlantic, Ameritech, and RUS
[7] BOC Notes on the Network, April 1994, Page 7-68 specifies that for non-loaded loops less than 18 Kft, that the maximum loop resistance is 1300 ohms.

- Maximum loop resistance of 900 ohms for the distribution plant beyond the RT. This equates to:
  - 9 Kft of 26 gauge cable
  - 12 Kft of 19, 22, or 24 gauge cable

Two electrical properties generally govern the design of outside plant - resistance and loss. Electrical resistance is important because it restricts the ability of the central office (or the loop electronics in the case of DLC) to deliver and receive network signals from the end user. It also affects the ability of the loop to deliver sufficient current to power the station set. Loop loss is important since it affects the quality of the signal received.

The maximum loss which can be tolerated in a POTS loop is -8dB measured at a frequency of 1 Khz. This level has been determined by extensive customer surveys by Bell Labs; these surveys found that at this level of loss, 90% of customers will rate the voice quality as "good" or "excellent".[8] Above this level of loss, customers will increasingly rate the quality of service as "fair", "poor" or "unsatisfactory". Loss and resistance are, of course, related. An 8 dB loss can generally be achieved by a loop with an electrical resistance of 1300 ohms. 15.6 Kft of 26 gauge copper or 25 Kft of 24 gauge copper can achieve a loop resistance of 1300 ohms (however, under RRD, loops over 18Kft must be loaded).[9] PBX and Centrex systems are less tolerant to loss, and are designed to a -5.5 dB standard.

In their comments, AT&T and MCI state that the 900 ohm CSA design standard employed in BCPM is incorrect, touting instead the 1500 ohms standard used in the

[8] BOC Notes on the Network, April 1994 Pages 7-36 to 7.38.

[9] These resistance values are valid at a temperature of 68°F, which is the design standard for buried or underground cable. The standard design criteria for aerial cable is 100°F in most parts of the United States, and up to 120° in parts of the southwestern US. At these temperatures resistance is increased by approximately 7% and 11%, respectively above the level experienced at 68°F. Thus, when aerial plant is included in the mix, the maximum distances will be reduced below those stated above, which must be considered in the design process.

Hatfield model[10] This assertion is not only erroneous, but also somewhat surprising. One would assume that AT&T would follows the directives of its own *Outside Plant Engineering Handbook*;[11] however, a review of the discussion of this topic in that missive finds a clear statement that 900 ohms is the design resistance limit within the CSA. In any event, the Hatfield sponsors have incorrectly interpreted the equipment specifications for the DSC line card used in their model. At page 19 of their comments, buried in footnote 40, documentation from the DSC Litespan©-2000 units is purportedly offered. However, what appears is only a portion of the relevant documentation. The following is the complete description of the Litespan-2000 Specifications:

> The Remote Terminal "Plain Old Telephone Service" (RPOTS) is the remote terminal subscriber interface to Litespan, ... Excluding the telephone set, a nominal 2 dB of loss is provided per line in each direction, supporting a practical loop length ranging from 0 to 1000 ohms. Including the telephone set, the maximum loop length is 1930 ohms.[12]

The key to understanding this section is the statement that the RPOTS card introduces 2 dB of loss into the circuit. This means that 2dB of the 8dB loss "budget", or the card takes up 25% of the total allowable loss for the loop. This leaves 6dB, or 75% of the total, for the outside plant. Since 0.75 x 1300 ohms = 975 ohms, it is easy to see why the manufacturer states that the maximum practical range for this system is 1000 ohms.

Conversely, the Hatfield sponsors calculate their 1500 ohm design standard by subtracting the 430 ohm station set from the 1930 ohms stated as the maximum loop length over which the system will work, meaning the transmission of signaling information to the central office. While the system will technically function at this

[10] AT&T/MCI at p. 19
[11] Dated August, 1994
[12] DSC Practice OSP 363-005-802, Issue 3, November 1995, RPOTS Unit Description, Page 1 of 4.

distance, it will do this with a degraded and sub-standard quality of the voice grade signal.

To further illustrate, the maximum distance for 26 gauge cable to deliver 6dB of loss is 11.7 Kft (15.6 Kft x 0.75 Kft=11.7Kft). By way of comparison, for 24-guage cable, the maximum distance is 18 Kft over an unloaded channel (25.0 Kft x 0.75 = 18.75 Kft, however, over 18 Kft, copper loops must be loaded).

The Hatfield model defines loops at 18 Kft. The only way to meet this is to deploy pure 24-gauge copper loops. Furthermore, these calculations have all been made at an assumed temperature of 68°F. To the extent that aerial cable is included in the design mix (where design standards range from 100°F to 120°F and resistance is 7% to 11% higher per foot) the maximum cable lengths will be less.

DSC, however, does provide a line card, known as the Remote Terminal Extended Range Universal Service Voice Grade (REUVG), for use in situations where the loop exceeds these practical limits. This card provides additional amplification to the circuit, allowing for its use over longer distances. In the documentation concerning this card, DSC states:

> The REUVG is typically used for special service applications and extended range loop lengths. Each REUVG provides provisioned transmission gain and equalization with adjustable hybrid balance for loops lengths up to and beyond the customer serving area (CSA) limits.[13]

Since the REUVG contains additional electronics, it costs more than the standard RPOTS line card. Our latest information indicates that the price for the REUVG card is approximately twice that of the RPOTS card[14]. Most other manufacturers of DLC equipment also offer standard line cards for loops up to approximately 900 ohms, as

[13] DSC Practice OSP 363-005-809, Issue 3, November 1995, REUVG Unit Description, Page 1 of 6
[14] Copies of the technical specifications for the RPOTS and REUVG units are found in Attachment A hereto.

well as higher priced extended range cards with amplification for applications beyond this length.

The Hatfield designers cannot have their proverbial cake and eat it too. Either the higher priced extended-range line cards must be included in their equipment costs, or they must conform to the loop design standards provided in the CSA. BCPM has built the network to take advantage of the economies inherent in the CSA design architecture. CSA provides for efficient state-of-the art network architecture which may be seamlessly connected to the worldwide telecommunications network. The Hatfield model provides a sub-standard network which operates at the ragged edge of functionality, particularly in remote rural areas. Perhaps RUS said it best when, describing Hatfield's shift from load coils to the use of digital T1 for loops greater than 18 kilofeet, it noted that Hatfield has traded a 50 year-old technology for a 25 year-old technology[15].

At page 15 of their comments, the Hatfield Sponsors allege that BCPM overbuilds its network in order to provide services which are more elaborate than those meeting the Commission's specifications for basic voice grade services. While the Joint Sponsors have answered this charge repeatedly, they will provide one final tutorial as to why the network is designed to go beyond the most basic of services. First, as directed by the Commission and the 1996 Act, the network envisioned by BCPM is designed in such a fashion so as not to impede the future deployment of advanced services.

Second, and perhaps more importantly, to take advantage of the economies of scope and economies of scale, all model sponsors have been instructed by the FCC to include business lines in their network design. Once a network is required to support

[15] RUS at p. 5

business requirements, the higher electrical demands of private branch exchange (PBX) switches must be supported; the same is true of ISDN. PBX and Centrex systems have higher resistance characteristics, and thus higher loss, than standard telephone sets. Therefore, the network must be designed to push the signal through that increased resistance. As stated above, PBX and Centrex loops are designed for a maximum loss of 4.5dB, rather than the standard 8dB. Although those services are not (and should not be) services supported by universal service subsidies, the fact remains that they must be designed into the network if the residential network is going to benefit from the cost savings of serving business customers.

The Hatfield Sponsors also claim that the BCPM "...over-engineers its network by placing fiber further [sic] out into the network than is necessary or cost effective to provide quality service, thus requiring placement of excessive numbers of digital loop carriers (DLCs) in the network."[16] The Commission must not be swayed by these hollow declarations. The truth is, considering prevailing pricing, current placement techniques, and significant savings in reduced maintenance costs, fiber is not the "gold-plate" anathema that the Hatfield sponsors have tried to suggest throughout this process. Fiber is often the economically preferred option, especially with regard to maintenance expense.

IV. Wireless

The Joint Sponsors were delighted to receive the information provided by both Northern Telecom (Nortel) and AirTouch Communications regarding the attributes of wireless technology. The Joint Sponsors are anxious to include wireless technology in the modeling for universal service obligations. To reiterate what we have stated in previous pleadings, the $10,000 cap that has been included in prior versions of the

BCPM was never meant to approximate an actual cost of wireless technology. Rather, it was merely a "placeholder" to indicate some threshold over which it may be more cost effective to utilize wireless technology. In the comments offered here, both Nortel and AirTouch state that wireless loop costs are well below the $10,000 "placeholder" level, while GTE states that its cost studies for wireless exceed $10,000 per line (at 15).

The Joint Sponsors stand ready to modify BCPM, if appropriate; however, at this point, the Joint Sponsors are not currently aware of a working wireless application that would be cost effective; but are enthusiastic at the prospect of working with Nortel[17] and AirTouch Communications in their search.

Respectfully submitted,

SPRINT LOCAL TELEPHONE
COMPANIES

By: Jay C Keithley

Jay C. Keithley
Sandra K. Williams
1850 M Street
Suite 1110
Washington, D.C. 20036
(202) 828-7453

BELLSOUTH CORPORATION
BELLSOUTH TELECOMMUNICATIONS, INC.

By: M. Robert Sutherland by JCK

M. Robert Sutherland
Richard M. Sbaratta
Rebecca M. Lough
Suite 1700
1155 Peachtree Street, N.E.
Atlanta, GA 30309-3610
(404) 249-3390

[16] AT&T/MCI at p. 17

[17] Nortel also raises the question of spectrum issues. Although important and critical to wireless concerns, those issues are outside the scope of this proceeding.

Joint Sponsors Reply Comments
October 3, 1997

US WEST, INC.

By: Robert B. McKenna by [illegible]

Robert B. McKenna
John L. Traylor
Suite 700
1020 19th Street, N.W.
Washington, D.C. 20036
(303) 672-2798

Of Counsel, Dan L. Poole

ATTACHMENT A

REMOTE TERMINAL POTS (RPOTS)

P/N: 300-1121-900

CONTENTS

1 GENERAL

1.01 The Remote Terminal "Plain Old Telephone Service" (RPOTS) is the remote terminal subscriber interface to Litespan, counterpart to the central office terminal CPOTS channel unit. The RPOTS channel unit is also used in the central office terminal for applications such as PBX off-premises line. RPOTS units are loop-start-only with a fixed compromise hybrid balance for operation on either loaded or unloaded loops in both the 600-ohm and 900-ohm environment. The RPOTS channel unit provides forward disconnect and optional on-hook transmission for custom local area signaling services (CLASS). Excluding the telephone set, a nominal 2 dB of loss is provided per line in each direction, supporting a practical loop length ranging from 0 to 1000 ohms. Including the telephone set, the maximum loop length is 1930 ohms.

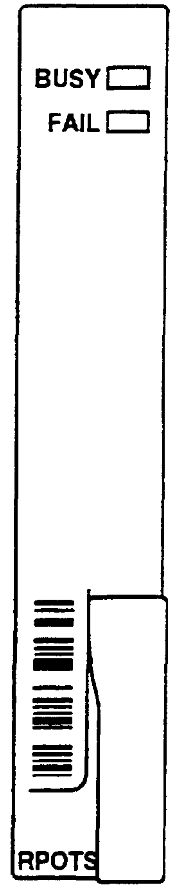

Figure 2-1
RPOTS

1.02 This is the third issue of this document. The loop current specifications have been changed, as has the definition of practical loop length (see above). The list of provisionable options with their limits and defaults has been replaced by a reference to the Channel Unit Provisioning Summary, OSP 363-005-300. This document describes the channel unit's functions which may be controlled through software.

1.03 Litespan channel units have no physical switches. All optioning information or provisioning is entirely controlled through software. Provisioning is accomplished from a co-located or remote computer terminal using TL1 or OMAPS.

1.04 The RPOTS provides foreign exchange station (FXS) functionality. In limited applications, the unit can also be used for locally switched, loop-start services, such as PBX trunks, WATS trunks and lines, or nonlocally switched, loop-start services. Each module supports four independent circuits. Refer to Narrowband Services Application Guide, OSP 363-205-110, for information on compatible hybrid circuits.

1.05 Litespan channel units provide metallic test access at the tip and ring for monitoring and maintenance or as an interface for such test systems as Pair Gain Test Controller (PGTC) or Extended Test Controller (XTC). Access is provided via the Metallic Test Access Unit (MTAU) that provides both monitor and split capabilities. Operation is software-controlled through TL1 or OMAPS.

2 PHYSICAL DESCRIPTION

2.01 The RPOTS is a printed circuit board plug-in module. Its physical dimensions are 4.42 inches high by 10.2 inches deep by 0.84 inches wide at the faceplate. The unit has a board extractor lever to ensure that the connector seats properly and to aid in the unit's removal.

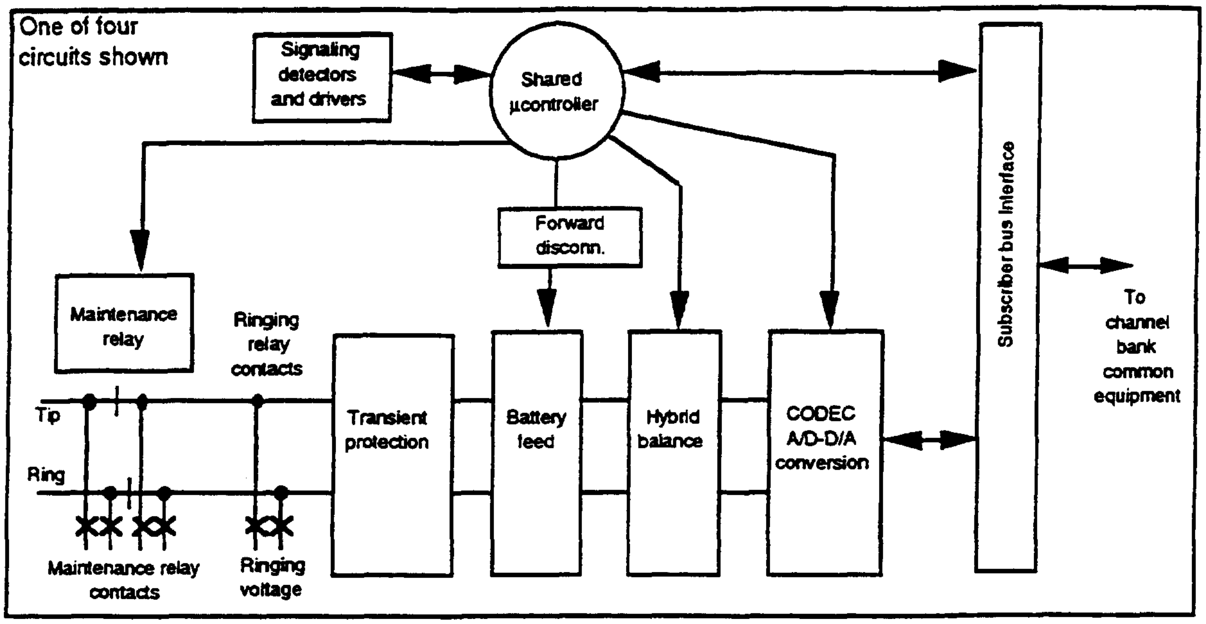

Figure 3-1. Simplified Functional Block Diagram

2.02 The front panel, as shown in **Figure 2-1**, is equipped with two LED indicators: green BUSY and red FAIL.

2.03 The pair assignments for the four circuits of a channel unit slot in a channel bank assembly when used with this linecard are given here. Refer to Channel Bank Assembly Unit Description, OSP 363-005-507, in the Mechanical Unit Descriptions, OSP363-205-270, for further information.

Pair 1, Ckt 1: T - R Pair 2, Ckt 2: T - R Pair 3, Ckt 3: T - R Pair 4, Ckt 4: T - R

3 FUNCTIONAL DESCRIPTION

3.01 The simplified functional block diagram is shown in **Figure 3-1**. Each line circuit includes the functional blocks described below.

3.02 A single, shared microcontroller analyzes all detector outputs and provides the appropriate timing, control, and communications functions between the channel unit and the Litespan system, directed over duplicate channel bank assembly (CBA) buses. A message-oriented data link is used for all CBA administrative communication and associated support, including alarms, protection switching and coordination, and program download.

3.03 The subscriber bus interface (SBI) is the link to the backplane of the CBA. Each channel slot is presented with redundant 2 Mb/s channels from the Time Slot Interchanger in the common control assembly (CCA) via the Bank Control Unit (BCU). The SBI terminates both redundant data buses.

3.04 Transient protection on the 2-wire line circuit protects the card from lightning and power crosses that could potentially damage or destroy the unit circuitry. Stringent component controls keep the impedance low to meet the requirements of the compromise hybrid balance.

3.05 Line battery feed is a constant-current supply designed for low-power dissipation while providing sufficient current to operate the telephone instrument.

3.06 Loop current is detected by the loop current sensing circuit when the telephone goes off-hook. This circuit is able to recognize dial pulses, which break the loop current at acceptable duty cycle rates in the presence of induced power and transient noise.

3.07 A ring-trip circuit senses when the telephone goes off-hook during ringing. This causes the central office switch to stop the ringing and connect the parties.

3.08 Conversion from 2-wire to 4-wire operation is performed by a solid-state hybrid with a compromise balance network. The hybrid balance network balances the impedance on both sides of the hybrid to minimize reflections.

3.09 A/D and D/A conversion is provided by a CODEC that sends and receives PCM signals to and from the channel bank backplane. The backplane interface provides the rate conversion and communications and provisioning access to the module.

3.10 The ringing relay is controlled by signaling from the central office switch. When ring signaling is received, the ringing relay operates to apply ring voltage (typically 20 Hz at 90 V) to the loop. Central office switch ringing is followed precisely to support distinctive ringing.

3.11 The forward-disconnect feature disconnects a called-end telephone which has put the incoming call on hold and left it, tying up that line. To drop the connection, the local switch times out and removes battery. Litespan sends that signal to the RT channel unit, which opens the loop to drop the call.

3.12 Maintenance relays are provided to get test access to both the carrier system and the subscriber loop. The relays provide access via the MTAU to monitor or split the line.

3.13 The front panel indicators are under direct control of the microcontroller. The FAIL LED is lit when the unit is first powered and will remain lit until the unit is successfully initialized. The length of time to complete this procedure is entirely dependent upon the activity of the Terminal Control Processor in the CCA. Otherwise, FAIL indicates the module is unable to operate as required. BUSY indicates that one of the four circuits is either carrying traffic or connected to the MTAU.

4 PROVISIONING AND MAINTENANCE

4.01 TL1 is the native communication language of the Litespan. Access to the Litespan system is achieved with a direct connection using an ASCII terminal, dial-up connection via a modem, or X.25 packet network. Refer to the TL1 Reference Practice, <u>OSP 363-205-502</u>.

4.02 OMAPS is a user-friendly software interface that provides provisioning and maintenance access to the Litespan system. OMAPS is a program that runs on an IBM PC-AT[1] or equivalent computer. Refer to the OMAPS Reference Practice, <u>OSP 363-205-501</u>.

4.03 Equipment alarm and condition reporting attributes and service states are provisionable. Alarms are assigned notification codes of CR (Critical), MJ (Major), MR (Minor), or NR (Not Reported). Alarms are also coded as SA (Service-Affecting) or NSA (Non-Service-Affecting).

4.04 The channel unit's characteristics, or facility options, which can be provisioned in software, are described in the Channel Unit Provisioning Summary, <u>OSP 363-005-300</u>, and in the software references. Further application-specific information is given in the Narrowband Services Application Guide, <u>OSP363-205-110</u>.

---

[1] IBM and PC-AT are trademarks of International Business Machines Corp.

5 SPECIFICATIONS

5.01 Specifications for this channel unit are given in **Table 5-1**.

Table 5-1. Specifications

PARAMETER	MIN	TYP	MAX	UNIT	CONDITIONS
Single-ended					
Loop length			1930	Ω	
Loop off-hook detection threshold			2.5k	Ω	
Loop on-hook detection threshold	8k			Ω	
Loop current		23		mA	Constant, 52-volt battery
Open circuit voltage	 43.5	50	 44.5	V V	Normal mode (52-volt bat) On-hook transmission mode
Input impedance		900		Ω	+2.16 µF
Nominal loss	-2.4	-2.0	-1.6	dBm	ref 2-wire 900Ω + 2.16 µF
VF overload level			+3	dBm	
Return loss per TR-303	28 20			dB	ERL SRL
Ring-trip detector	2500			Ω	65 - 100 VRMS, 16 - 40 Hz
Ring-trip delay			100	msec	65 - 100 VRMS, 16 - 40 Hz
Longitudinal balance		65		dB	1000 Hz
Hybrid balance impedance		900		Ω	
Temperature range	-40 -40		+65 +149	°C °F	
Humidity range	5		95	%	Noncondensing
End-to-end system (with Litespan CPOTS)					
Frequency response	-1		1	dB	300 to 3000 Hz, ref 1004 Hz
Gain tracking	-0.5 -1.0 -3.0		0.5 1.0 3.0	dB	-37 to +3 dBm0 -50 to -37 dBm0 -55 to -50 dBm0
Idle channel noise			19	dBmC	
Signal to distortion	33 27 22			dB	0 to -30 dBm0 -30 to -40 dBm0 -40 to -45 dBm0
Net loss	-2.8	-2.0	-1.2	dBm	900Ω + 2.16 µF terminations
On-hook transmission loss	-3.5	-2.0	-0.5	dBm	900Ω + 2.16 µF terminations
Return loss	20 14 18 14			dB	ERL, 900Ω + 2.16 µF ERL, 900Ω + 2.16 µF RT SRL, 900Ω + 2.16 µF SRL, 900Ω + 2.16 µF RT
Dial pulse distortion			5	%	
Ringing envelope delay distortion			200	msec	
Open interval distortion		20		msec	

REMOTE TERMINAL EXTENDED-RANGE UNIVERSAL VOICE GRADE (REUVG)

P/N: 300-1131-900

CONTENTS

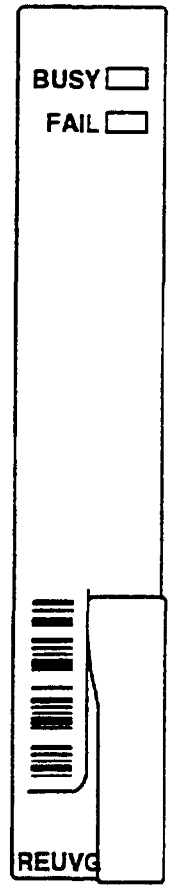

Figure 2-1
REUVG

1 GENERAL

1.01 The Remote Terminal Extended-Range Universal Voice Grade (REUVG) channel unit is the subscriber interface for the Litespan, counterpart to the central office terminal CEUVG channel unit. The REUVG is typically used for special service applications and extended-range loop lengths. Each REUVG provides provisioned transmission gain and equalization with adjustable hybrid balance for loop lengths up to and beyond customer service area (CSA) limits. Line circuits may be provisioned to operate with loaded cable. In universal Litespan applications, the CEUVG and REUVG cards operate together to provide a 2-wire analog interface to the CO switch. The REUVG card supports ground-start/loop-start and reverse-battery signaling. Reverse-battery signaling supports direct inward dialing (DID) for use with PBX systems.

1.02 This is the third issue of this document. The list of provisionable options with their limits and defaults has been replaced by a reference to the Channel Unit Provisioning Summary, OSP 363-005-300. This document describes the channel unit's functions which may be controlled through software.

1.03 Litespan channel units have no physical switches. All optioning information or provisioning is entirely controlled through software. Provisioning is accomplished from a co-located or remote computer terminal using TL1 or OMAPS.

1.04 The REUVG is a multifunctional module that supports foreign exchange station (FXS), dial pulse originating (DPO), private line automatic ringdown (PLAR), and extended transmission only with gain transfer and sealing current (ETO/GT/SC) functionalities. Each module supports four independent circuits. Refer to Narrowband Services Application Guide, OSP 363-205-110, for information on compatible hybrid circuits.

1.05 Litespan channel units provide metallic test access at the tip and ring for monitoring and maintenance or as an interface for such test systems as Pair Gain Test Controller (PGTC) or Extended Test Controller (XTC). Access is provided via the Metallic Test Access Unit (MTAU), which provides both monitor and split capabilities. Operation is software-controlled through TL1 or OMAPS.

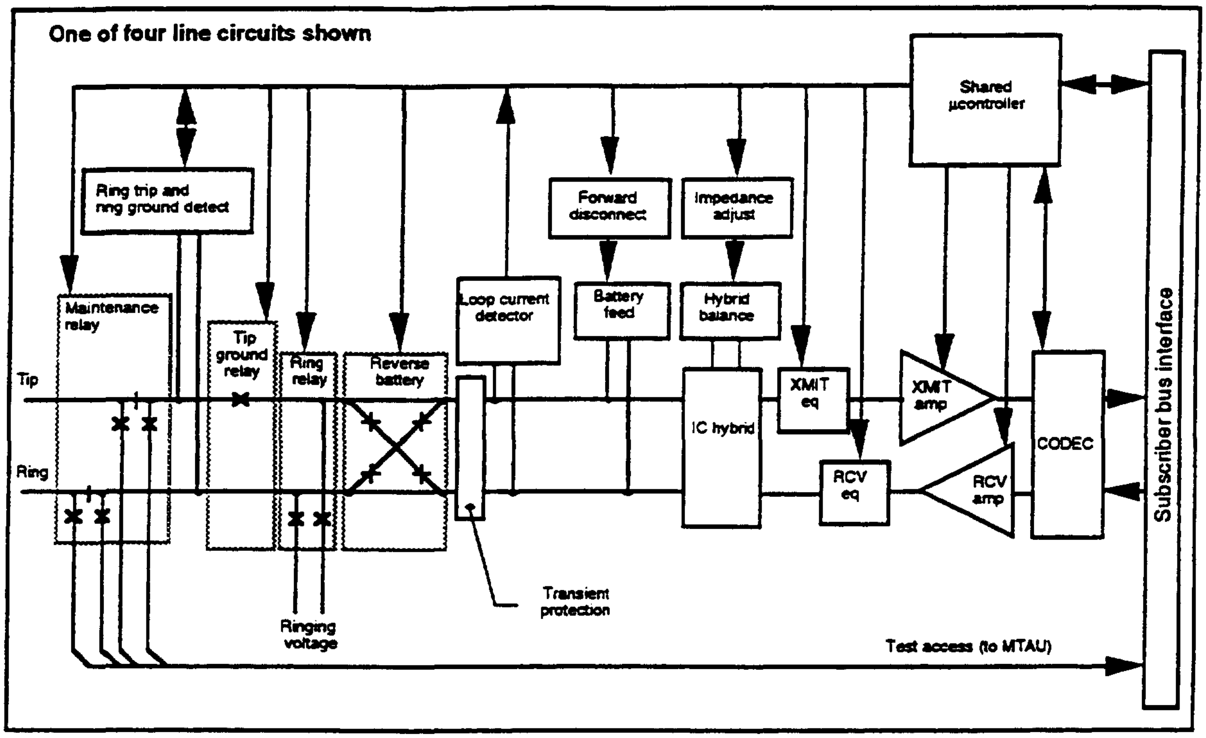

Figure 3-1. Simplified Functional Block Diagram

2 PHYSICAL DESCRIPTION

2.01 The REUVG is a printed circuit board plug-in module. Its physical dimensions are 4.42 inches high by 10.2 inches deep by 0.84 inches wide at the faceplate. The unit has a board extractor lever to ensure that the connector seats properly and to aid in the unit's removal.

2.02 The front panel, shown in **Figure 2-1**, has two LED indicators: green BUSY and red FAIL.

2.03 The pair assignments for the four circuits of a channel unit slot in a channel bank assembly when used with this linecard are given here. Refer to Channel Bank Assembly Unit Description, OSP 363-005-507, in the Mechanical Unit Descriptions, OSP363-205-270, for further information.

Pair 1, Ckt 1: T - R   Pair 2, Ckt 2: T - R   Pair 3, Ckt 3: T - R   Pair 4, Ckt 4: T - R

3 FUNCTIONAL DESCRIPTION

3.01 The simplified functional block diagram is shown in **Figure 3-1**. Each line circuit include the functional blocks described below.

3.02 A single, shared microcontroller is shared by the individual line circuits. The microcontroller analyzes all detector outputs and provides the appropriate timing, control, and communications functions between the channel unit and the Litespan system directed over duplicate CBA buses. A message-oriented data link is used for all CBA administrative communication and associated support, including alarms, protection switching and coordination, and program download.

3.03 The subscriber bus interface (SBI) is the link to the backplane of the CBA. Each channel slot is presented with redundant 2 Mb/s channels from the Time Slot Interchanger in the common

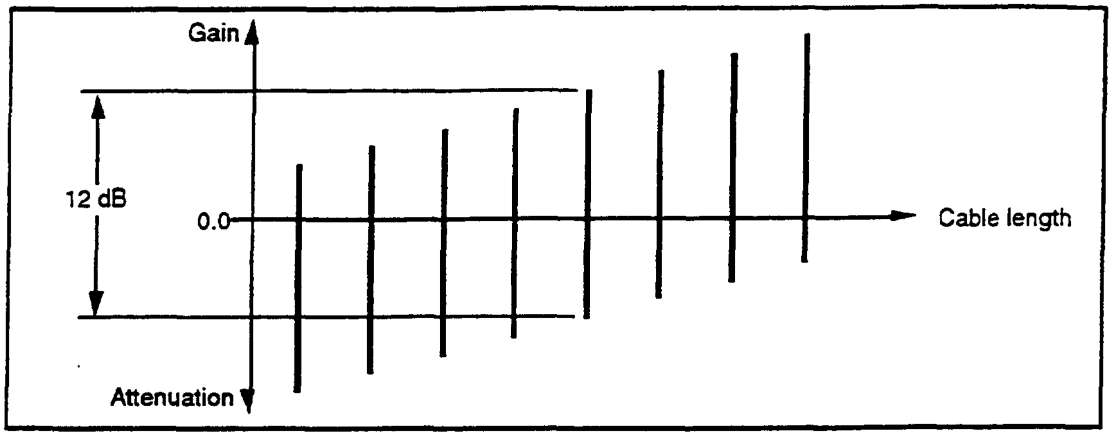

Figure 3-2. TLP Relationship to Cable Length

control assembly (CCA) via the Bank Control Unit (BCU). The SBI terminates both redundant data buses.

3.04 Analog-to-digital and digital-to-analog conversion is provided by a CODEC that sends and receives PCM signals to and from the channel bank backplane.

3.05 Equalization is set automatically according to the hybrid balance setting provisioned.

3.06 The conversion from 2-wire to 4-wire operation is performed by an integrated circuit hybrid (part of the CODEC) with an adjustable balance network. The hybrid balance network may be set to one of 72 fixed settings for nonloaded cable and 18 fixed settings for loaded cable to balance impedances of both sides of the hybrid and minimize reflections.

3.07 Transmit and receive transmission level point (TLP), gain or attenuation, may be independently set for each circuit to fixed levels in 0.1 dB increments. TLP ranges are a function of the balance setting: cable length, loading, and impedence. The combined TLP range, gain and attenuation, for any one balance setting is 12 dB. In general, TLPs provide for more attenuation and less gain at shorter loop lengths; whereas for longer loops lengths, TLPs provide for more gain and less attenuation. This feature is shown in **Figure 3-2**.

3.08 Line battery feed sufficient for operation of the telephone instrument is provided by a constant-current supply designed for low-power dissipation. The battery feed may be disconnected and the loop opened to drop a call upon receipt of the forward-disconnect signal from the CEUVG card.

3.09 Each circuit includes the following detectors; loop current, ring trip, ring ground, and loop length. Circuit response in the various signaling modes is described under circuit operation.

3.10 The impedance adjustment provides 600Ω or 900Ω off-hook impedance, as provisioned in software.

3.11 Maintenance relays are provided to each line for test access to both the carrier system and the subscriber loop. The relays provide access via the MTAU to open or bridge the line.

3.12 The REUVG card is protected from lightning and power crosses.

3.13 The front panel indicators are under direct control of the microcontroller. The FAIL LED is lit when the unit is first powered and will remain lit until the unit is successfully initialized. The length of time to complete this procedure is entirely dependent upon the activity of the Terminal Control Processor in the CCA. Otherwise, FAIL indicates the module is unable to